



DAAC-Specific Data Server Subsystem Hardware Design

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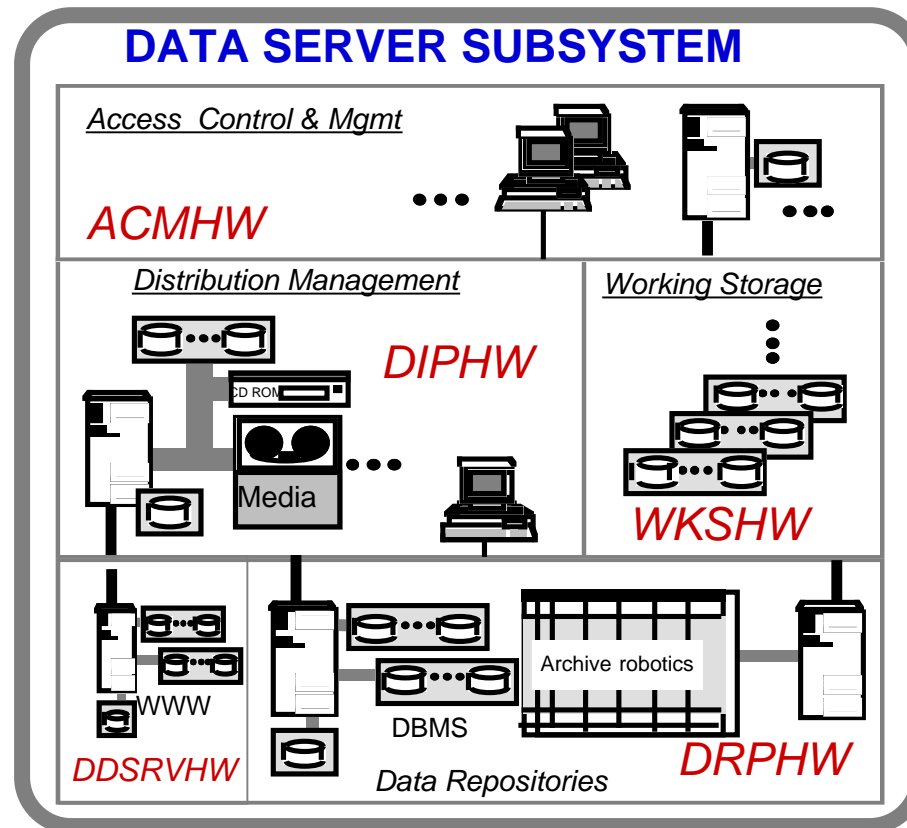
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DAAC-Specific Data Server Subsystem Hardware Design



- 1. Data Server Subsystem Configuration**
- 2. Release B Hardware Design Drivers and Constraints**
- 3. Design Methodology**
- 4. Equipment Allocation**
- 5. Conclusion**

Data Server Subsystem Configuration



DAAC-Specific Data Server Subsystem Hardware Design



1. Data Server Subsystem Configuration

2. Release B Hardware Design Drivers and Constraints

3. Design Methodology

4. Equipment Allocation

5. Conclusion

Release B Hardware Design Drivers and Constraints



1. Data Rates
2. Volume Accumulations
3. Interim Products' Volume and Rates
4. Transaction Patterns
5. Archival Media Considerations

Design Drivers - Steady State Data Rates* (in MB/sec)**



SITE	TOTAL INPUTS TO THE ARCHIVE	TOTAL OUTPUTS FROM THE ARCHIVE
GSFC	12.19	39.39
LaRC	8.61	6.48
EDC	10.93	9.98
NSIDC	1.18	5.84
JPL	0.71	1.81
ASF	0.98	1.37

* Static Analysis of the Technical Baseline

** Rates represent 1x Processing and 1x Reprocessing



Design Drivers - Volume Accumulation*

SITE	Epoch k (June 1999) [TB]	Year 2003 [TB]
GSFC	179.30	2,206.00
LaRC	49.44	485.00
EDC	194.64	1,061.00
NSIDC	6.02	40.70
JPL	7.46	18.80
ASF	1.11	2.50

* Nominal Accumulations



Design Drivers - Interim Products

Interim Products require non-permanent storage

Interim Products are intermediate products used in generating final, permanently archived, products

The main component of this accumulation of data is in support MODIS L3 processing (all the Interims produced between subsequent L3 processing campaigns)

Maximum lifetime of an Interim Product is 90 days

Design Drivers - Interim Products Steady State Data Rates* (in MB/sec)



SITE	INTERIM PRODUCTS INPUT TO WKS	INTERIM PRODUCTS OUTPUT FROM WKS
GSFC	11.20	2.60
LaRC	7.80	7.20
EDC	19.00	41.00
NSIDC	0.20	negligible
JPL	negligible	negligible
ASF	negligible	negligible

* Static Analysis of the Technical Baseline

Design Drivers - Interim Products



SITE	PEAK ACCUMULATION [GB]
GSFC	158.50
LaRC	314.80
EDC	6,403.00
NSIDC	negligible
JPL	0.71

- **Impact:**
 - At LaRC and GSFC additional quantities of disk are required at the WKS level
 - At EDC high access rate ATLs (STK Powderhorns with Timberline linear drives) are added at the WKS level

Design Drivers - Transaction Patterns (Files/Hour)*



Average Data File Size of 95 MB

SITE	TOTAL INPUTS TO THE ARCHIVE	TOTAL OUTPUTS FROM THE ARCHIVE	INTERIM PRODUCTS INPUT TO WKS	INTERIM PRODUCTS OUTPUT FROM WKS
EDC	414	378	720	1554
LaRC	326	246	296	273
GSFC	462	1493	424	100
NSIDC	45	221	8	negligible
JPL	27	69	negligible	negligible
ASF	37	52	negligible	negligible

* Average number of 95 MB Data File Transactions per hour based on 24 hour steady state rates

Impact:

- Use of faster Robotic devices (STK) at GSFC and EDC in combination with the Helical Scan D3 tape drives (due to high volume accumulation)

Design Drivers - Archival Media Considerations



DSS is transaction bound at all sites

- **High performance linear scan tape drives (10 GB) (except at EDC and GSFC)**
- **EMASS Robotics (except at EDC and GSFC)**

DSS is also capacity driven at GSFC and EDC

- **High performance helical scan tape drives (50 GB)**
- **STK Robotics**

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4. Equipment Allocation (e.g. EDC)
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Hardware Design - Methodology



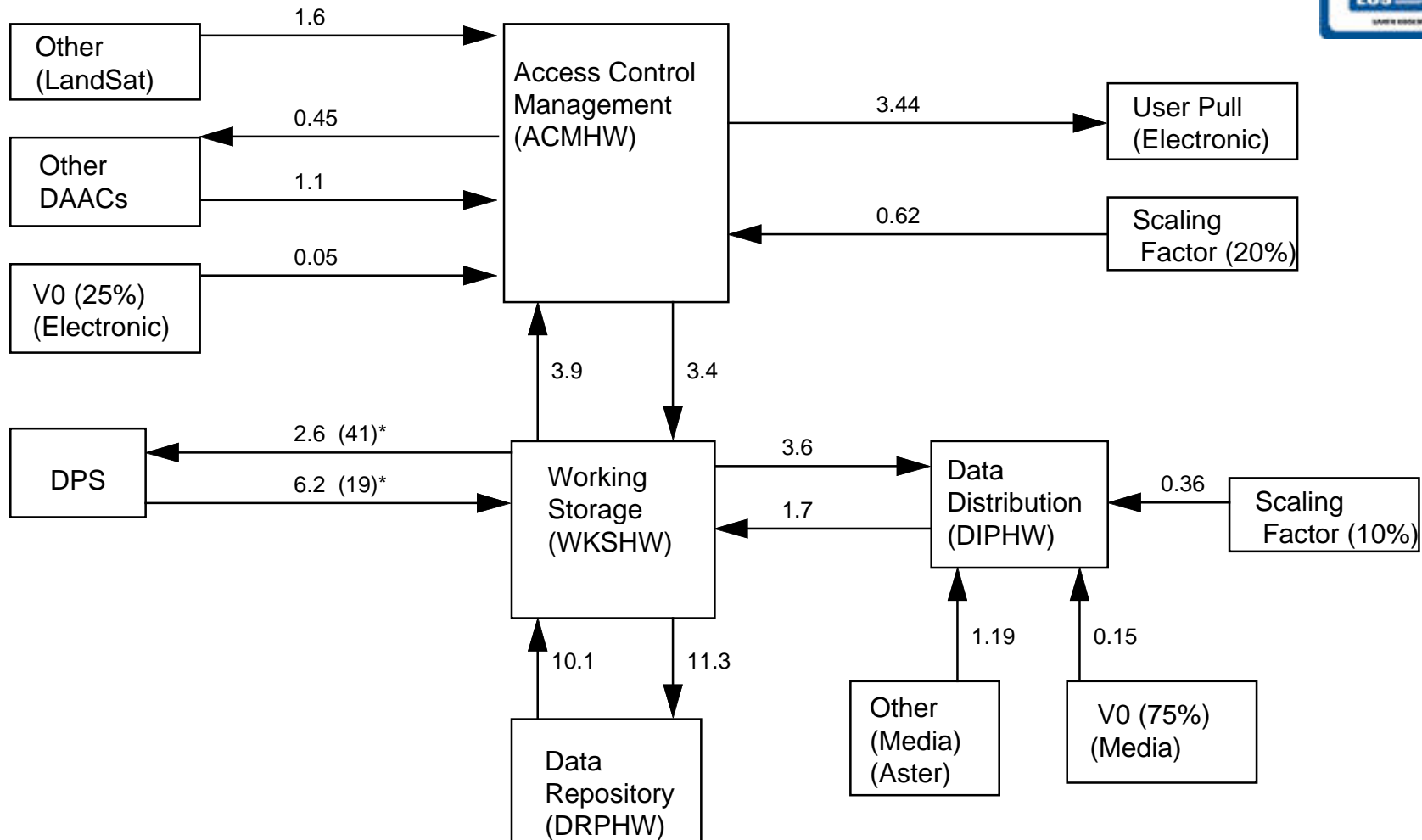
- **Evolutionary Process From Release A**
- **Steady State Modeling was used to determine the hardware design of the Data Repository and Working Storage**
- **Static Modeling of the February 1996 Technical Baseline by the Modeling Group supplied Processing Data Flows and Interim Data Flows**
- **Applied Dynamic Modeling Results from the August 1995 Technical Baseline to establish transaction patterns and specific data flow multipliers**

Hardware Design - Methodology (cont.)



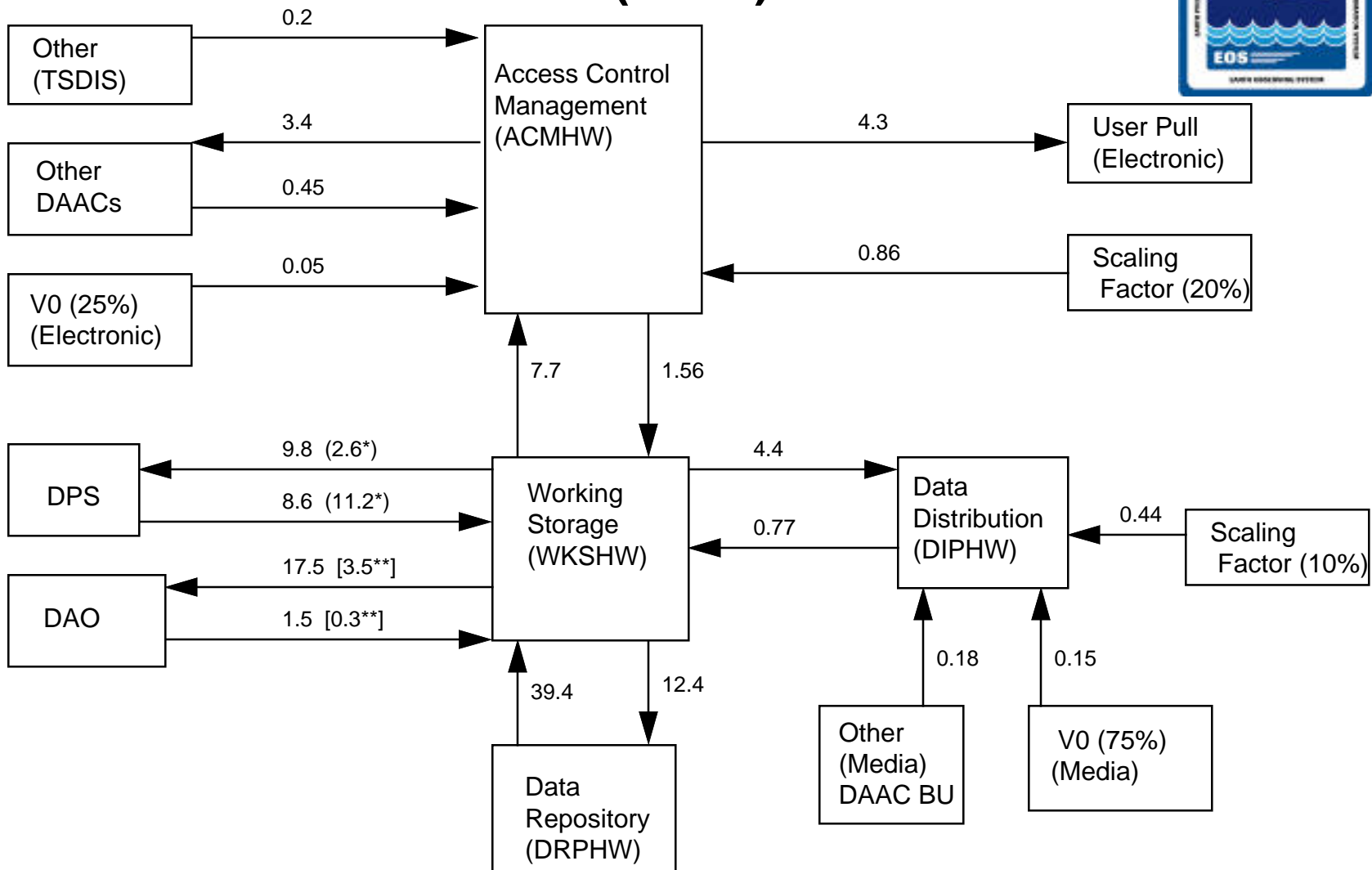
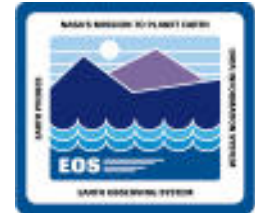
- **Data Rates**
- **Transaction Mitigation**
 - Serendipity Factor
- **Data Accumulations**

Design Methodology - Data Rate Characterization (MB/s) at EDC



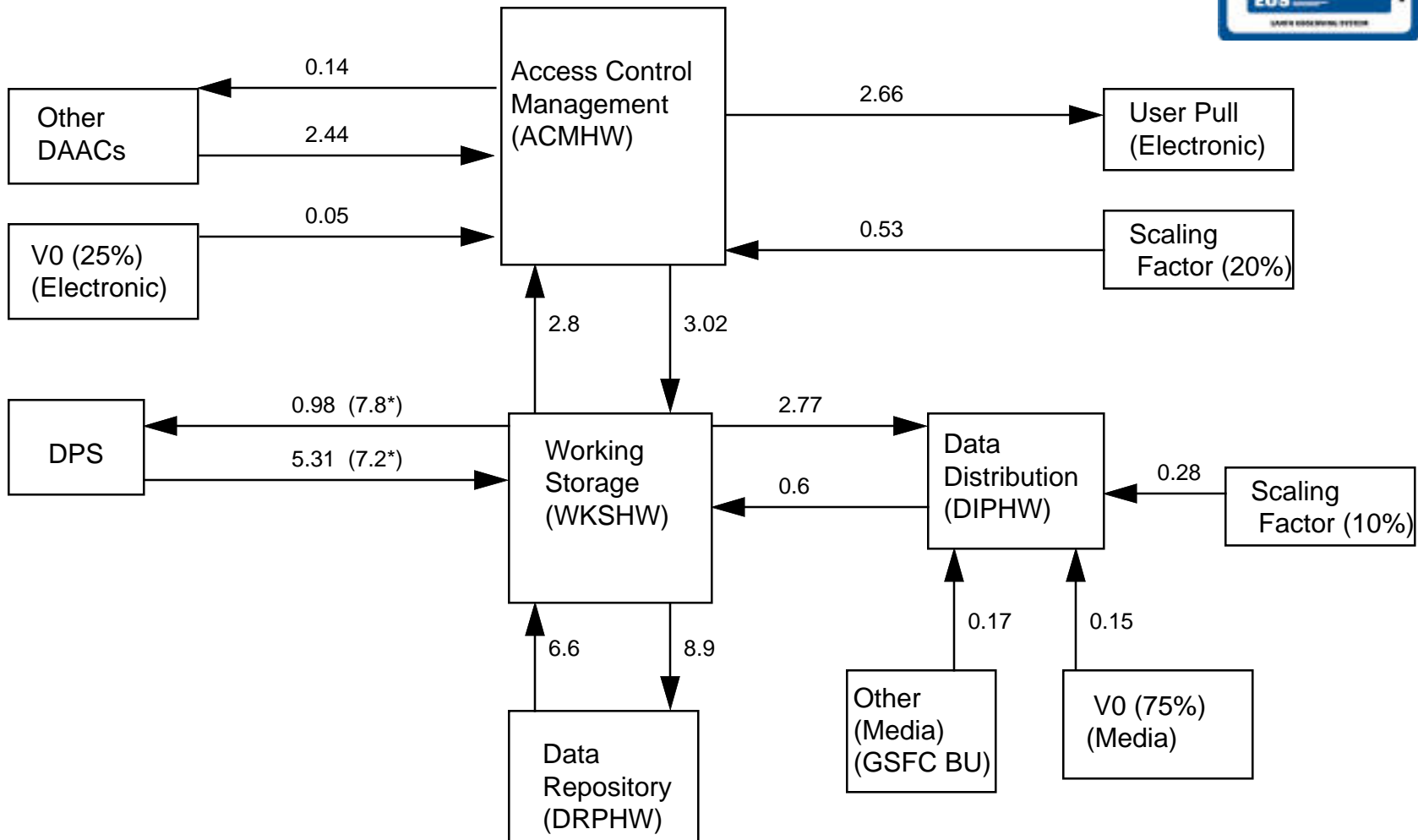
All Flows Represent Nominal Rates at Steady State over 24 hours
in MB/s for the Technical Baseline (Epoch K) with some static inputs
* Interim Products

Design Methodology - Data Rate Characterization (MB/s) at GSFC



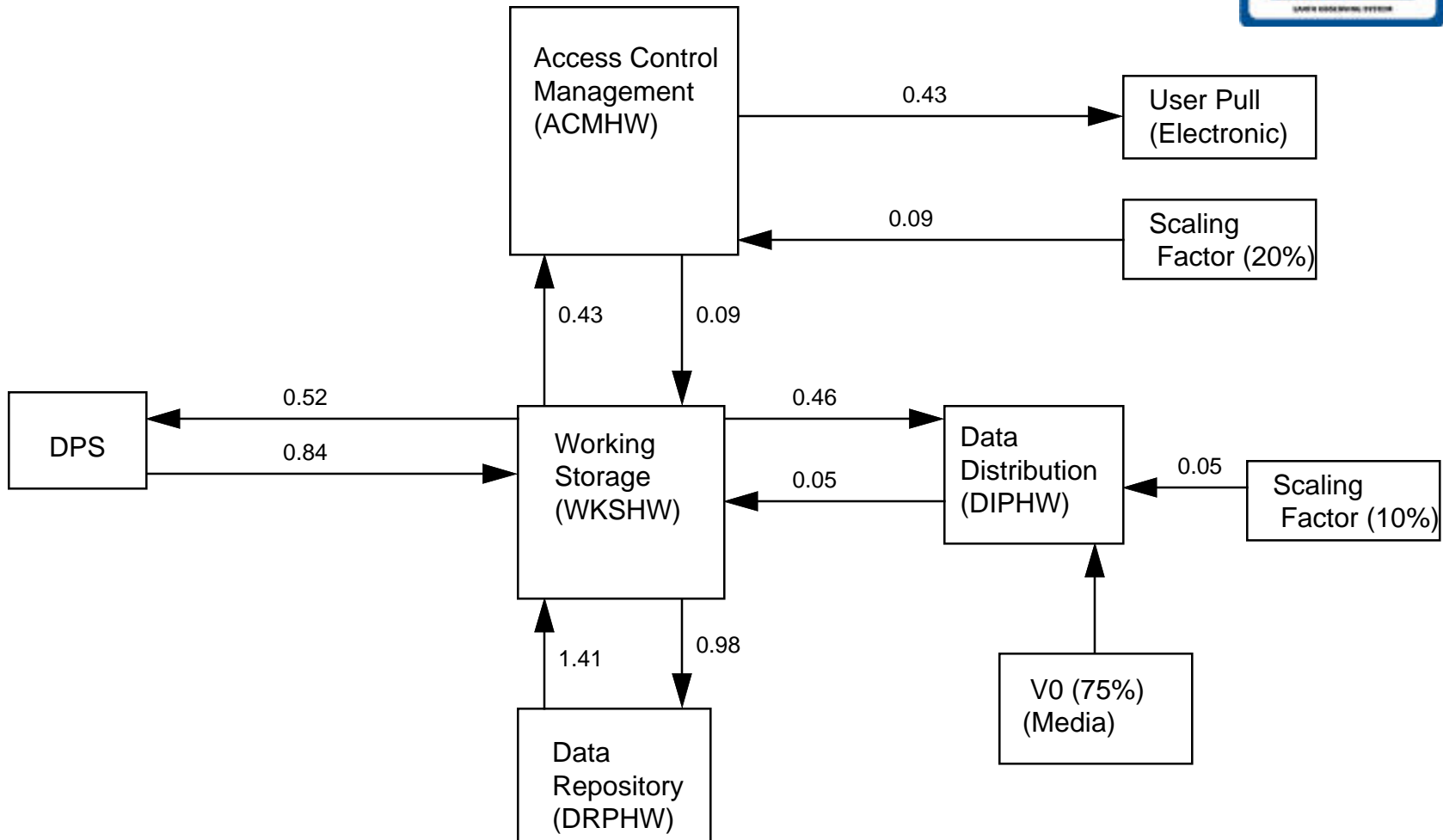
All Flows Represent Nominal Rates at Steady State over 24 hours in MB/s for the Technical Baseline (Epoch K) with some static inputs
 * Interim Products; ** "First" and "Final" actual figures.

Design Methodology - Data Rate Characterization (MB/s) at LaRC



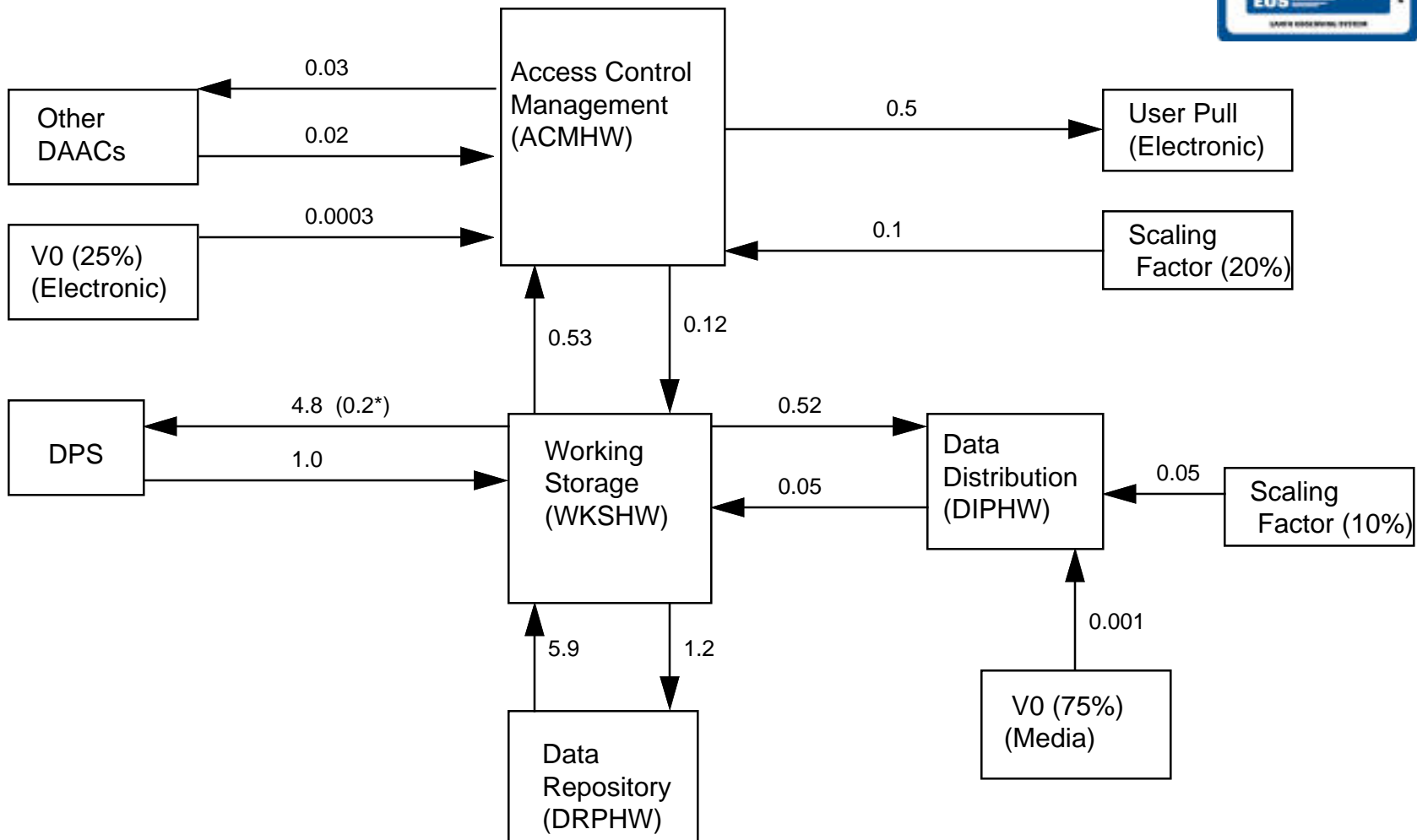
All Flows Represent Nominal Rates at Steady State over 24 hours in MB/s for the Technical Baseline (Epoch K) with some static inputs
* Interim Products

Design Methodology - Data Rate Characterization (MB/s) at ASF



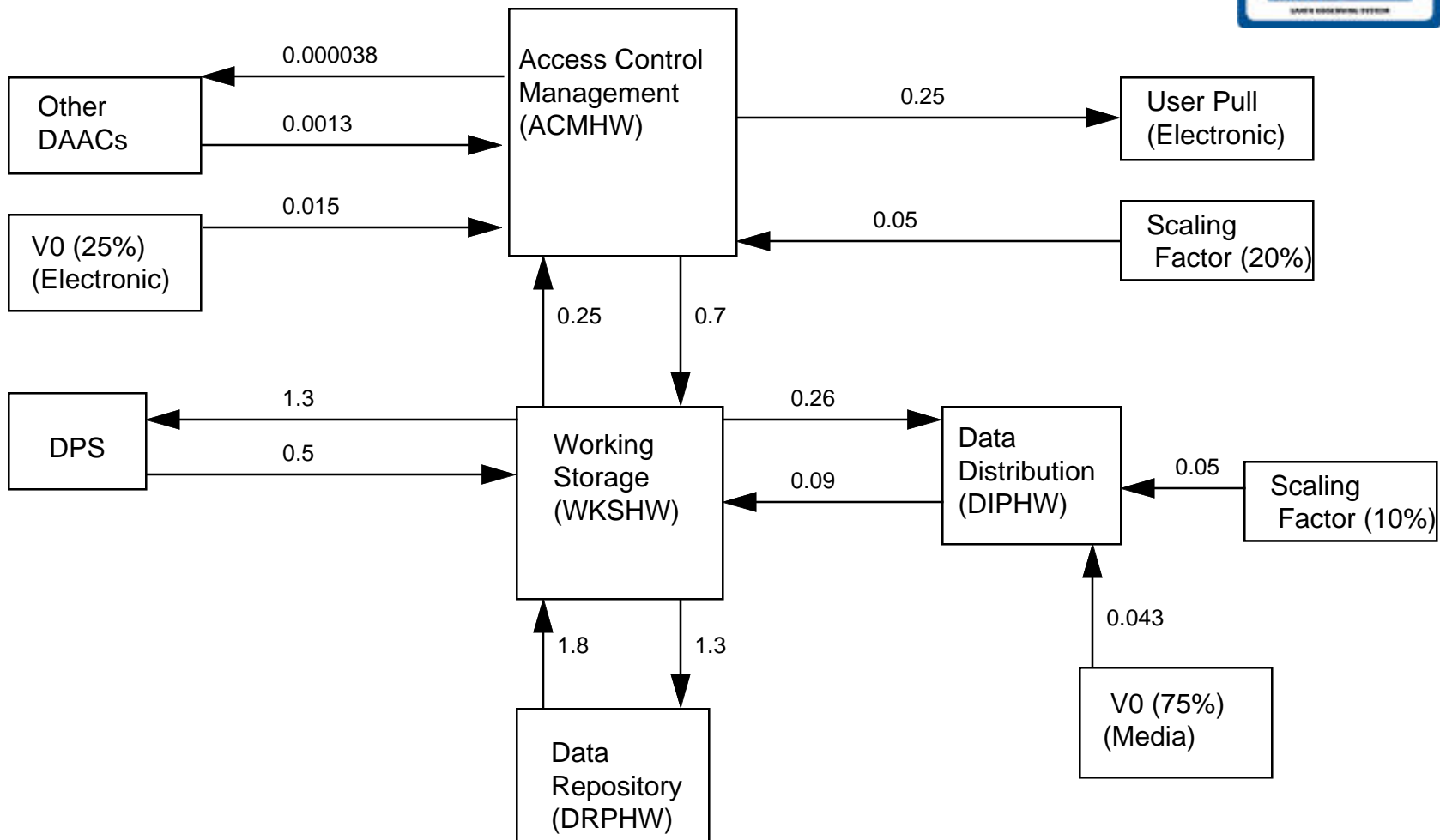
All Flows Represent Nominal Rates at Steady State over 24 hours
in MB/s for the Technical Baseline (Epoch K) with some static inputs

Design Methodology - Data Rate Characterization (MB/s) at NSIDC



All Flows Represent Nominal Rates at Steady State over 24 hours
in MB/s for the Technical Baseline (Epoch K) with some static inputs
* Interim Products

Design Methodology - Data Rate Characterization (MB/s) at JPL



All Flows Represent Nominal Rates at Steady State over 24 hours
in MB/s for the Technical Baseline (Epoch K) with some static inputs

Data Repository Volume Groups



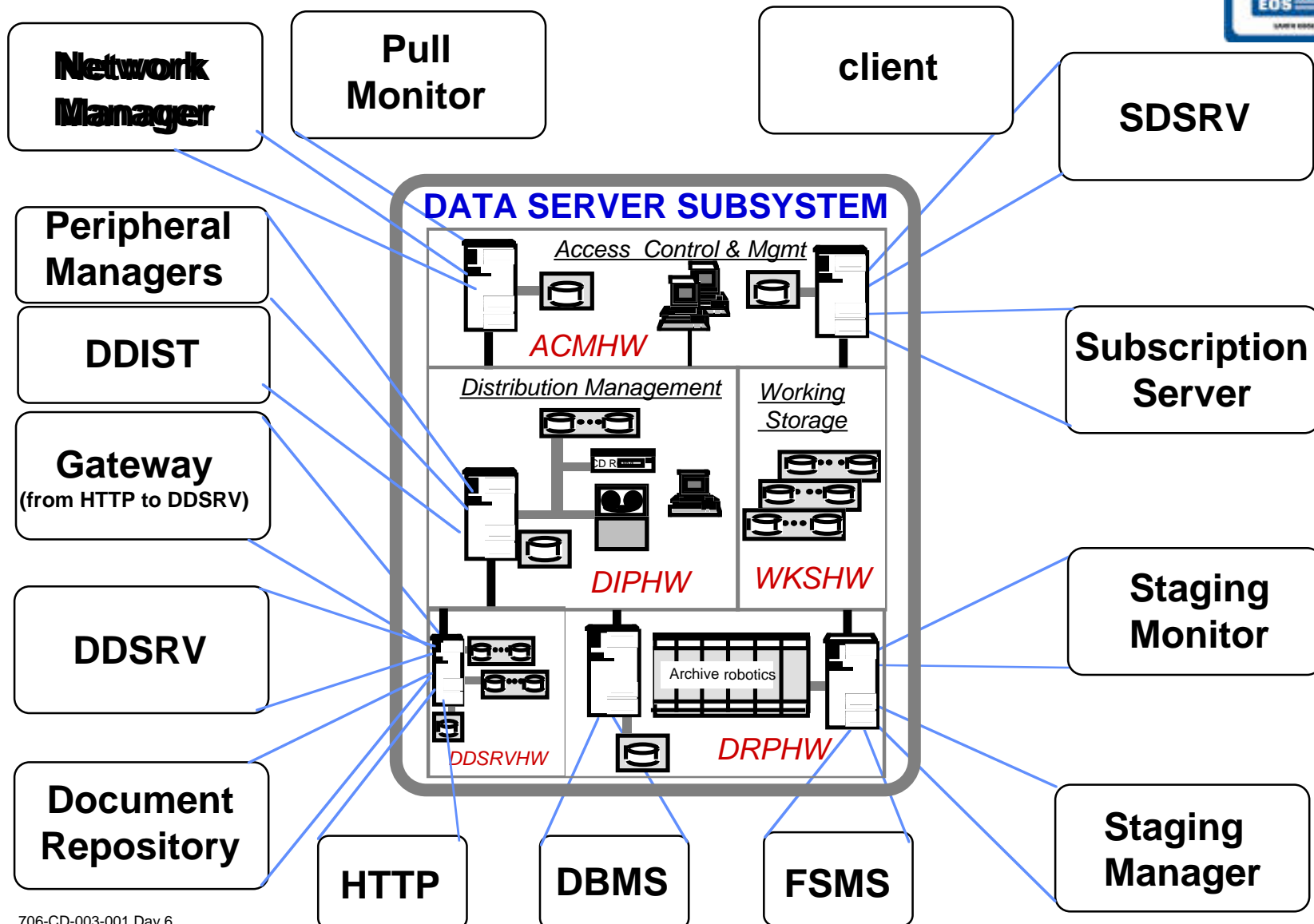
- **Volume groups are used in the Data Repository to spread data transfers among various tape resources.**
- **Increasing the number of volume groups per ATL, increases the number of concurrent writes possible per ATL.**
- **Spreading volume groups over multiple ATLs, provides fault tolerance to a system by insuring that not all data for a particular application will be in a single ATL.**

Hardware Design - Methodology (Host Sizing)

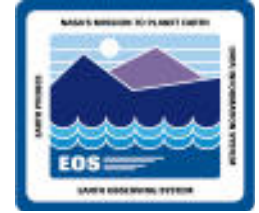


- **CPU Sizing**
 - **Processes**
 - **Data Flow**
 - **Peripheral Interfaces**
 - **Communications interfaces**
- **Disk Sizing**
 - **Data Rates**
 - **Data Residency**
 - **FSMS Caching**
 - **All RAID is specified as SGI RAID 5 (SCSI-2 based)**

Process Mapping



Host Sizing - Rationale



Quantifying CPUs for the hosts in each HWCI was accomplished using:

assumptions, testing, dynamic modeling outputs, SGI Rules of Thumb (SGI/RT), and combinations of two or more methods. RAM allocation was determined using SGI/RT.



Host Sizing - Rationale (cont.)

The following characteristics were used for sizing, (where appropriate):

- | | |
|------------------------------------|--------------------|
| 1. Subsetting / Subsampling | Dynamic Modeling |
| 2. Subscription Processing | Dynamic Modeling |
| 3. Monitoring Functions | Analysis |
| 4. Operating System / Applications | Analysis |
| 5. Clients (Session Threads) | Analysis |
| 6. HIPPI I/O | Analysis - Testing |
| 7. FDDI I/O | SGI/RT |
| 8. Total SCSI I/O | SGI/RT |
| 9. Total RAID I/O | SGI/RT |
| 10. FSMS | SGI/RT - Testing |

Hardware Design - Methodology (Peripheral Sizing)



- **Automated Tape Library Sizing**
 - **Data Rates**
 - **Transaction Rates**
 - **Volume Accumulation**
- **Distribution Peripheral Sizing**
 - **Data Rates**
 - **Operational Hours**

DAAC-Specific Data Server Subsystem Hardware Design



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Data Server Subsystem

EDC Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	SUN Ultra	2 ea.
APC Hosts	22 CPU SGI Challenge XL, 6 GB local disk, 2 GB RAM	1 ea.
	12 CPU SGI Challenge XL, 6GB local disk, 1 GB RAM	1 ea.
APC Disk	682.5 GB of RAID Disk	
WKSHW		
	10 CPU SGI Challenge XL, 6 GB local disk, 1 GB RAM	1 ea.
	6 CPU SGI Challenge XL, 6 GB local disk, 512 MB RAM	1 ea.
	421 GB RAID	
	STK Powderhorn ATLs with 16 3490e tape drives	2 ea.
DRPHW		
FSMS Server Host	6 CPU SGI Challenge XL, 6 GB local disk, 512 MB RAM	2 ea.
AMASS Cache	50 GB RAID Disk for AMASS cache (total of 300 GB RAID)	
ATL Robotics	STK Powderhorn with 16 D3 drives per ATL	2 ea.
Tape Media	D3 50 GB cartridges	8,042 ea.
DBMS Server	2 CPU SGI Challenge XL, with 20 GB shared disk	2 ea.
DIPHW		
Staging Server Host	Sun Ultra 4-slots, with access to 310GB RAID disk	2 ea.
Peripherals:	8 mm tape drives (with stackers)	12 ea.
	4mm tape drives (with stackers)	12 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	20 ea.
	FAX	1 ea.
	3480/3490 outboard drives	4 ea.
	printer	2 ea.
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

Data Server Subsystem

GSFC Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	SUN Sparc 20/50	2 ea.
APC Hosts	16 CPU SGI Challenge XL, 6 GB local disk, 1 GB RAM	1 ea.
	8 CPU SGI Challenge XL, 6 GB local disk, 512 MB RAM	1 ea.
	764 GB RAID disk	
WKSHW		
	10 CPU SGI Challenge XL, 6 GB local disk, 1 GB RAM	1 ea.
	6 CPU SGI Challenge XL, 6 GB local disk, 1GB RAM	1 ea.
	558.5 GB, minimum RAID disk	
DRPHW		
FSMS Server Host	6 CPU SGI Challenge XL, 6 GB local disk, 512 MB RAM	3 ea.
AMASS Cache RAID	200 GB	
ATL Robotics	STK Powderhorn	5 ea.
Tape Drives	16 D3 drives per each of the four ATLs	64 ea.
	12 D3 drives in one ATL	12 ea.
Tape Media	D3 50 GB cartridges	6,942 ea.
DBMS Server	2 CPU SGI Challenge XL, 30 GB shared disk	2 ea.
DIPHW		
Staging Server Host	SUN Ultra 4-slot, with access to 480 GB of Disk	2 ea.
Peripherals:	8 mm tape drives (with stackers)	15 ea.
	4mm tape drives (with stackers)	15 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	25 ea.
	FAX	
	3480/3490 outboard drives	4 ea.
	printers	2 ea
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

Data Server Subsystem

LaRC Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	Sun Ultra	2 ea.
APC Hosts	10 CPU SGI Challenge XL, 6 GB local disk, 1 GB RAM	1 ea.
	6 CPU Challenge XL, 6 GB local disk, 512 MB RAM	1 ea.
	480 GB RAID disk	
WKSHW		
Workstation Hosts	6 CPU SGI Challenge XL, with 6 GB local disk, 512 MB RAM	1 ea.
	4 CPU Challenge XL, 6 GB local disk, 256 MB RAM	1 ea.
	415 GB RAID disk	
DRPHW		
FSMS Server Host	6 CPU SGI Challenge XL, 6 GB local disk, 512 MB RAM	
	4 CPU SGI Challenge XL, 6 Gb local disk, 256 MB RAM	
	100 GB RAID disk	
ATL Robotics	AMASS AML Model 2 Tall Quadro Tower system, 2 robot arms	3 ea.
Tape Drives	3590 (NTP) drives	30 ea.
Tape Media	3590 tape cartridges	5,571 ea.
DBMS Server	2 CPU SGI Challenge XL, with 12 GB shared disk	2 ea.
DIPHW		
Staging Server Host	4 CPU Sun Ultra 4-slot, 6 GB local disk, 256 MB RAM access to 235 GB of RAID	2 ea.
Peripherals:	8 mm tape drives (with stackers)	10 ea.
	4mm tape drives (with stackers)	10 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	16 ea.
	FAX	1 ea.
	3480/3490 outboard drives	4 ea.
	printer	2 ea.
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

Data Server Subsystem

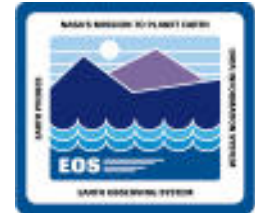
JPL Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	SUN Ultra	2 ea.
APC Hosts	6 CPU SGI Challenge Ls, 6 GB local disk, 45 GB RAID	2 ea.
WKSHW		
	60 GB local disk, 5 GB of RAID	
DRPHW		
FSMS Server Host	6 CPU SGI Challenge L, 6 GB local disk, 512 MB RAM	1 ea.
FSMS Server Host	4 CPU SGI Challenge L, 6 GB local disk, 256 MB RAM	1ea.
	60 GB RAID	
ATL Robotics	EMASS ABBA/E; 1 robotic arm, 1 Quadro Tower	1 ea.
Tape Drives	3590 drives	5
Tape Media	3590 tape cartridges (10 GB each)	1, 709
DBMS Server	2 CPU SGI Challenge XL, 10 GB shared disk	2 ea.
DIPHW		
Staging Server Host	SUN Ultra 4-slot, with access to 23 GB of RAID Disk	2 ea.
Peripherals:	8 mm tape drives (with stackers)	2 ea.
	4mm tape drives (with stackers)	2 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	2 ea.
	FAX	
	3480/3490 outboard drives	2 ea.
	printers	2 ea
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

Data Server Subsystem

NSIDC Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	SUN Ultra	2 ea.
APC Hosts	6 CPU SGI Challenge Ls, 6 GB minimum local disk	2 ea.
	87 GB RAID disk	
WKSHW		
	20 GB RAID disk	
DRPHW		
FSMS Server Host	6 CPU SGI Challenge L, 6 GB local disk, 512 MB RAM	1 ea.
	4 CPU SGI Challenge L, 6 GB local disk, 256 MB RAM	1 ea.
	20 GB RAID disk	
ATL Robotics	2 robot arms EMASS AML/2 with large Quadro Tower	1 ea.
Tape Drives	3590 (NTP) Tape drives	8 ea.
Tape Media	3590 tape cartridges	1,326 ea.
DBMS Server	2 CPU SGI Challenge DM, 10 GB shared disk	2 ea.
DIPHW		
Staging Server Host	SUN Ultra 4-slot, with access to 135 GB of Disk	2 ea.
Peripherals:	8 mm tape drives (with stackers)	2 ea.
	4mm tape drives (with stackers)	2 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	3 ea.
	FAX	
	3480/3490 outboard drives	2 ea.
	printers	2 ea.
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.

Data Server Subsystem

ASF Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	Sun Ultra	2 ea.
APC Hosts	6 CPU SGI Challenge Ls, 76 GB of RAID disk	2ea.
WKSHW		
	60 GB RAID	
DRPHW		
FSMS Server Host	6 CPU SGI Challenge Ls	2 ea.
FSMS Server Host	4 CPU SGI Challenge Ls	2 ea.
	60 GB of RAID	
ATL Robotics	EMASS AML/E with Hex Tower storage unit, robot arm	12 TB capacity (NTP)
Tape Drives	3590 (NTP) Drives	5ea.
Tape Media	3590 (NTP) Tape Cartridges 10 GB ea.	359 ea.
DBMS Server	2 CPU SGI Challenge XLs, with 12 GB of shared disk	2 ea.
DIPHW		
Staging Server Host	SUN Ultra 4-slot, with access to 120 GB of Disk	2 ea.
Peripherals:	8 mm tape drives (with stackers)	3 ea.
	4mm tape drives (with stackers)	3 ea.
	6250 tape drive	1 ea.
	CD ROM drive and jukebox	5 ea.
	FAX	
	3480/3490 outboard drives	2 ea.
	printers	2 ea
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

Data Server Subsystem

ORNL Hardware



HW CI	Equipment	Quantity
ACMHW		
Admin. Workstations	Sun Ultra	2 ea.
APC Hosts	4 CPU SGI Challenge L, 6 GB local disk, 256 MB RAM	2 ea.
	100 GB RAID disk	
DRPHW		
DBMS Server	2 CPU SGI Challenge L, with 10 GB shared disk	2 ea.
DDSRVHW		
WAIS/http Data Server	CPU SMP Server - SUN Ultra 4-slot, 6 GB local disk, 256 MB RAM	2 ea.
Data Server Disk	6 GB mirrored in two machines	

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